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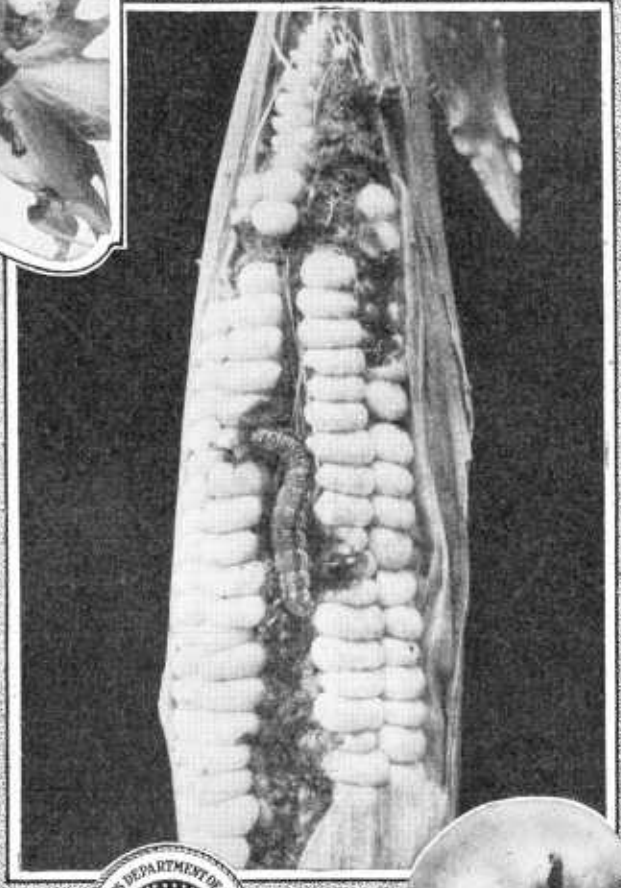
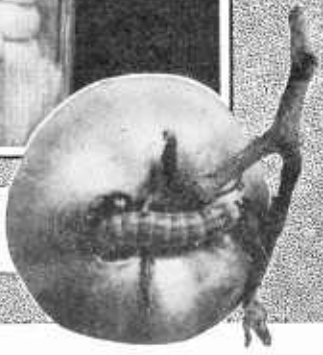
The BOLLWORM OR CORN EARWORM





THE BOLLWORM or corn earworm is an important enemy of cotton, corn, tomatoes, and tobacco. It feeds also on many other cultivated and wild plants.

As the winter is passed in the pupa or resting stage, 4 to 6 inches below the surface of the soil, late fall or winter plowing will cause the death of many pupæ. This is probably the most important of all control practices.

Since the insect increases greatly in numbers late in the season and hard bolls of cotton and ripening corn ears are largely immune to attack, it is important that these crops be matured as early as possible.

The caterpillar, except when it first hatches from the egg, feeds by boring into the fruit or stalk of the plants attacked; hence poisoning must be done at the right time to give best results. Poisoning of cotton with calcium arsenate, powdered arsenate of lead, or Paris green should take place when the corn ears in the main crop become hard; that is, about July 10 to August 20, according to latitude and season. Tomatoes may be largely protected by applications of the poison, begun as soon as injury to the plants appears and repeated at weekly intervals until 10 days before picking. Tobacco buds may be treated by dropping a teaspoonful of a mixture of arsenate of lead and corn meal into them.

Corn used as a trap crop gives some protection to cotton and tomatoes. For cotton the corn should be planted so as to come into silk and tassel when the ears of the early crop are hardening. To protect tomatoes the corn should be planted at intervals so as to be kept in silk through the greater portion of the fruiting period of the tomatoes.

Contribution from the Bureau of Entomology

L. O. HOWARD, Chief

Washington, D. C. Issued October, 1917; revised February, 1922

THE BOLLWORM OR CORN EARWORM.[1]

By F. C. BISHOPP, *Entomologist.*

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COTTON BOLLWORM, corn earworm, tomato fruitworm, and false budworm of tobacco are common names applied to one and the same insect when it is found attacking these various crops. In fact the insect is a very general feeder, attacking many wild plants as well as garden vegetables, alfalfa, cowpeas, and the crops indicated above.

The bollworm, or corn earworm as it is most widely known, occurs as a pest in practically all parts of the United States. The corn crop is widely affected, and the loss to this crop, including sweet corn, exceeds the damage to any other single crop. This was estimated in 1905 to be about $18,000,000 annually, and in the absence of later statistics it is safe to assume that the annual losses at the present time greatly exceed this amount. The loss to cotton raisers on account of its depredations was placed at $8,500,000 each year. This injury to cotton is most severe in parts of Texas, Oklahoma, and Arkansas. There is also considerable injury some seasons in Louisiana, Mississippi, and Alabama. (See fig. 1.) The total annual tax of this insect on the farmer can be conservatively placed at nearly $30,000,000. Despite these startling figures the fact that the insect has been present as a pest in this country for many years has caused most farmers to become tolerant of it. Under the present stress of world need it becomes doubly necessary to put forth every effort to reduce these losses to a minimum.

CHARACTER OF INJURY.

The character of attack on all the principal crops affected is similar. The caterpillars usually bore into and feed within the plant

[1] Known scientifically as *Heliothis obsoleta* Fab.; order Lepidoptera, family Noctuidae.

tissue. The first damage to corn is caused by boring into the bud and eating down into the tender leaves as they unfold. (See fig. 2.) A little later this injury often seriously affects the tassels before they have opened out, and when the silks appear eggs are laid upon them and young corn earworms burrow down through the silks and attack the small kernels, as shown in the illustration on the title-page. The tips of the ears are injured first; later, especially in tender varieties such as sweet corn, the earworms sometimes eat completely to the base of the ear and almost destroy it. In some regions practically every ear of sweet corn is more or less damaged and throughout the entire country from 70 to 98 per cent of the ears of field corn are attacked. Following this injury molds frequently gain access to the ears and damage them still further. This is especially true during wet seasons. Such conditions are often followed by an abnormally large number of cases of death among stock from the so-called cornstalk disease which seems to be caused by certain molds which develop on corn.

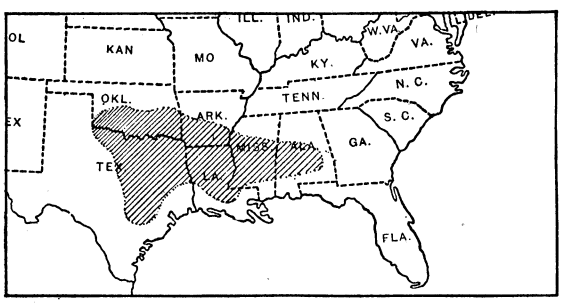

FIG. 1.—Map showing approximately the area in which the bollworm inflicts severe injury on cotton.

In the case of cotton the injury is readily distinguished from that caused by the boll weevil, as the squares and more tender bolls are completely eaten out, particularly after the worms have gained considerable size. Occasionally full-grown bolls are gnawed into by the large caterpillars and from one to all of the locks of cotton damaged. (See fig. 3.) Bolls which have become hard are seldom fed upon to any extent.

Injury to tomatoes consists principally of damage to the green or partially ripened fruit, but the young bollworms sometimes also bore into the growing tips of the plants and occasionally destroy the flowers as well.

In tobacco the injury consists of the penetration of the small leaves in the growing tip, hence the common name of budworm. A related caterpillar,[1] however, attacks tobacco in a very similar manner. A single caterpillar may render several leaves unfit for wrapper by penetrating the bud.

[1] Known scientifically as *Chloridea virescens* Fab.

HABITS OF THE INSECT AND HOW IT DEVELOPS.

A general knowledge of the life history and habits of an insect is needed in order intelligently to combat it. The bollworm or corn ear-

FIG. 2.—Young corn plant showing injury to growing tip by bollworm. (Quaintance.)

worm when mature (fig. 4) is a moth or miller about 1½ inches across the spread wings. It varies in color from a light brown or olive green to pale yellow and it is commonly seen flying about in the

evening. These moths feed upon nectar of various flowers and when mature they deposit from nearly 500 to almost 3,000 eggs. The eggs (fig. 5) are laid on various parts of the plant and to some extent upon weeds and upon the ground. They are white or yellowish in color, oval, and covered with minute ridges running from top to bottom and still smaller ridges across these. They are large enough to be seen readily with the naked eye. The eggs hatch in from 2½ to 8 days or even longer, depending upon the temperature.

FIG. 3.—Cotton boll with full-grown bollworm eating into tip. Natural size. (Quaintance.)

When first hatched the larvæ or caterpillars are extremely small. They feed here and there on the surface of the plant near where the eggs were laid, but gradually work toward some tender portion within which they can bore. Growth is rather rapid, being completed in about 20 days. The larvæ shed their skins four or five times during this period. When full grown they are about 1½ inches in length. The color varies from pale green to almost black. During the last few days of the life of the caterpillar it is capable of consuming large quantities of food, and it is during this period that it is most destructive.

When fully fed the larvæ leave the plant and burrow into the ground, where they form a kind of cell in which they transform into chrysalides or pupæ of a mahogany brown color. (See fig. 6.) They remain in this quiescent stage for about two weeks except in the case of the last brood in the fall, which stays in the ground until warm weather the following spring. The depth at which these cells are formed by the larvæ in summer varies from 1 to 4 inches according

to the hardness of the soil. The overwintering pupæ are formed at somewhat greater depths, usually 4 to 6 inches. These chrysalides or pupæ produce moths which in turn lay eggs, thus completing the entire life cycle in about 30 days during warm weather.

That there is a definite connection between weather conditions and injury to the cotton crop by this insect is generally recognized. Cloudy and rainy weather during the latter part of July and throughout August undoubtedly is conducive to severe injury. This is partially explained by the moistening of the soil, which permits the moths to emerge without difficulty, and by the stimulating effect of the moisture on the growth of stalks and leaves of cotton at this time, which favors bollworm development. Furthermore, it has been found that the prevalence of such weather conditions lessens the effectiveness of certain minute parasites which prey upon the bollworm in the egg and larva stages.

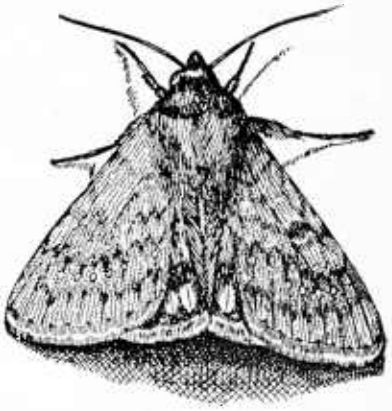

FIG. 4.—Bollworm moth with wings folded in natural position. About twice natural size. (Quaintance.)

SEASONAL HISTORY AND RELATION OF ABUNDANCE TO CROP GROWTH.

As has been stated, the bollworm or corn earworm pupa passes the winter months in the soil. Early in the spring the moths begin to come out, and by the time corn is "knee high" they are ready to deposit eggs. On account of the number of pupæ which die from adverse conditions in the winter, the first generation usually is small and the damage is not so appreciable. The second generation appears about the time the corn is in silk and tassel, and the number of moths is increased greatly. The caterpillars reach their full development about the time the ears of early corn become hard. In the South the third generation is the one which is destructive to cotton, the corn at this time being for the most part hard and dry. In the North this generation develops on late corn and other crops, and under usual weather conditions is the last of the season, while in the South four or even five generations may develop during a year. The late caterpillars feed on various green crops, including late cotton, cow-

FIG. 5.—Egg of bollworm moth, side and top views. Highly magnified. (Quaintance and Brues.)

peas, and alfalfa. Thus in the Southern States most of the overwintering insects will be found in soil where cotton and other late-growing crops are raised, while in the North the late cornfields probably contain most of them.

The bollworm shows a preference for corn when this crop is "silking," and this fact can be utilized to some extent in protecting cotton and other crops from injury, as will be pointed out later. These caterpillars are cannibalistic, and when they come in contact with one another many of them are killed, which usually reduces the number of worms developing in a single year to one, two, or at most three, whereas dozens of eggs may be laid upon a single strand of corn silk.

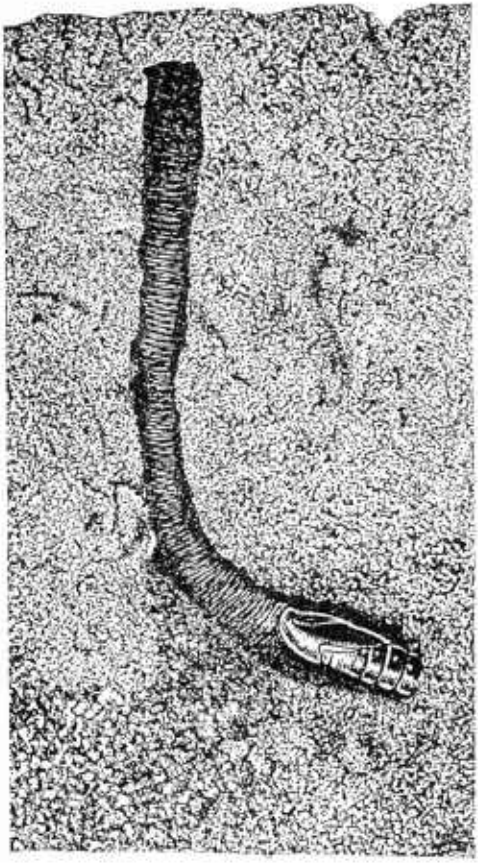

FIG. 6.—Vertical section through soil, showing pupa of bollworm in its burrow. About natural size. (Redrawn from Quaintance and Brues.)

CONTROL MEASURES.

As a result of the study of the life history and the seasonal history of this insect it will be seen that there are four outstanding facts which can be made use of in control work:

First, the insects spend the winter in the pupa stage in the ground. They also spend some time between generations in the soil. This enables the farmer to destroy many of them by plowing at the proper time.

Second, the caterpillars feed for a time on the surface of the leaves before penetrating the tissues of the plant. This is the only time during which the insect can be poisoned successfully.

Third, the number of bollworms or earworms increases greatly as the season advances. This indicates a need for hastening the maturity of all crops affected.

Fourth, since green corn is preferred as food, it is possible to utilize this to some extent as a trap to protect cotton and other crops.

It has been found that by modifying slightly the usual farm practices much can be done toward lessening bollworm or corn earworm injury. Fortunately these modifications are such as to increase crop production, regardless of the presence of this insect. Another important point is that some of the recommendations for controlling this insect are equally applicable, irrespective of the crop grown.

FALL AND WINTER PLOWING.

Probably the most important single step in controlling the bollworm consists of thorough breaking of the land in which the worms have buried themselves for the winter, at some time during the late fall or winter months. Particular attention should be paid in this respect to the crops which are known to have bollworms developing during the late fall months. The practice of fall and winter plowing, aside from bollworm control, is desirable because it conserves moisture, puts the ground in better condition for planting, and enables the farmer to plant at the proper time the following spring.

It has been found that the breaking up of the cells in which the insect is spending the winter results in the destruction of practically every pupa through the action of cold and moisture. Since the cells of the wintering brood are formed at from 4 to 6 inches beneath the surface, it is important that the plowing be deep enough to reach them. It is desirable to plow or deeply disk the fence rows and other places where bollworms may have fed on various plants. This is also beneficial in destroying eggs of grasshoppers and hibernating places of chinch bugs and other destructive insects.

CONTROL ON CORN.

CULTURAL METHODS.

In addition to the employment of fall and winter plowing, the injury to corn can be reduced somewhat by planting as early in the spring as is compatible with getting the ground into good condition. The corn should be as nearly uniform in age as possible and every effort should be made to hasten growth and maturity. Keeping the crop free from weeds and grass during the growing season not only tends to increase the yield but also destroys hiding places of the moths.

POISONING CORN.

Unfortunately no very satisfactory method of poisoning the worms on corn has been devised. As many as 50 per cent may be destroyed, but the remainder will gain entrance to the ears and produce the

usual injury. Recent work conducted in Kansas by Mr. J. W. McCulloch and in Missouri by Mr. Leonard Haseman indicates that the application of powdered arsenate of lead to the silks as soon as they begin to appear will reduce the injury considerably. Owing to the rapid growth of the silk and the fact that the eggs are deposited continuously, it is necessary to make a light application of poison at three or four day intervals to secure good results. In the experiments mentioned the poison was blown onto the ears with a dust gun or applied by hand with a cheesecloth bag. The cost of application and material probably would more than offset the advantage gained under field conditions, and this method will be more applicable in protecting sweet corn or corn grown especially for roasting ears, and in reducing the amount of injury to special selections grown for seed purposes.

CONTROL ON COTTON.

CULTURAL PRACTICES.

Several of the measures best calculated to reduce bollworm injury in the cotton-growing States are equally effective in checking the ravages of the boll weevil. No loss of money or energy results from putting such cultural practices into effect, even though the bollworm should not appear in very destructive numbers in any particular year.

To protect cotton from bollworm injury it is important (1) that early maturing seed be selected; (2) that the crop be planted as early as is consistent with getting a good stand and having the crop start off well; (3) that poor lands be fertilized and cultivation be thorough and frequent. Every step should be taken which will hasten the early maturity of fruit and keep the plants in a healthy, growing condition. The reason for this can be seen readily when we know that the bollworms pass to the cotton when the corn becomes mature, and that hard bolls are not subject to injury. Since the moths hide in the foliage when the growth is luxuriant, those varieties which make comparatively small stalk without a superabundance of leaves are desirable. This also hastens the drying out of the bolls after they are grown. The early and complete destruction of cotton stalks as recommended for the boll weevil will prevent the maturity of many late bollworms and destroy a considerable number outright.

POISONING COTTON.

The use of poisons against the bollworm has met with considerable success when the poisons have been applied at the proper time. Attention has been directed to the fact that a large proportion (from 60 to 80 per cent) of the eggs deposited in cotton fields are placed elsewhere than on the squares and flowers. Following hatching,

therefore, it is necessary for the young larvæ to travel a considerable distance before penetrating the fruit. During this rather aimless wandering the insect eats here and there from the surface of the leaves and stalks. During this short period in the existence of the larva it is susceptible to the action of various arsenical poisons.

The importance is emphasized of getting the poison on the plants when the numerous young larvæ of the August generation begin to hatch and not after the larvæ have grown to considerable size. In the later stages they are largely protected from the poison by their habit of burrowing into the squares and bolls and not feeding on the surface where the poison is deposited.

The time for applying the poison to cotton varies slightly from year to year. The first application should be made when the corn ears are becoming hard. The actual date will range from about July 10 to August 20, according to latitude and seasonal conditions. Close examination of the cotton plants at this time will show the earliest hatched bollworms making minute holes into squares. Often their presence may be detected by the delicate webs which the young worms sometimes spin about the squares.

Calcium arsenate, powdered arsenate of lead, or Paris green may be used for poisoning, but since the department is advocating the use of calcium arsenate against the boll weevil and since that product is being prepared especially by chemical companies for use on cotton it is to be recommended above the others. It has an advantage over Paris green in not burning the cotton plants and in being less dangerous to apply. It is more poisonous to insects than arsenate of lead and is much cheaper.

While it is possible to apply poison to cotton in the form of a spray (Paris green 1 pound, water 50 gallons), this method is usually impractical, and dust applications are advised. If Paris green is used it is best to mix it thoroughly with some carrier such as air-slaked lime at the rate of 1 pound to 3 of the carrier and make application at the rate of 6 to 9 pounds of the mixture per acre, according to the size of the plants. In using calcium arsenate from 4 to 5 *pounds without any diluent* should be applied per acre.

As the use of calcium arsenate as an insecticide is comparatively new and as there is some difficulty connected with the making of a satisfactory product it is advised that those ordering this material for use against the bollworm should call for a product having the specifications given by Mr. B. R. Coad, of the Bureau of Entomology, for use against the boll weevil. These are as follows:

Arsenic pentoxid, not less than 40 per cent.
Water-soluble arsenic pentoxid, not more than 0.75 per cent.
Density not less than 80 or more than 100 cubic inches per pound.

This gives a very light fluffy powder which forms an excellent dust if blown on the cotton with force.

The method of application should depend on the acreage to be treated. For poisoning small areas up to about 25 acres hand dust guns which are on the market may be used. About 3 acres a day can be covered with one of these. For larger acreages wheel-traction dusters are obtainable and for very large areas power blowers may be advisable.[1]

Some may prefer the old-fashioned method of applying poison with a bag and pole. This method lacks thoroughness and while satisfactory for controlling the leafworm it does not give best results against the bollworm. This equipment may be carried across the back of a mule, the poison being jarred out through the bags by movements of the animal and by tapping the pole. The construction of one of these outfits is very simple. Rectangular bags of 8-ounce duck are nailed to either end of a 4-inch board of a length equal to the distance between two cotton rows, as is shown in figure 7.

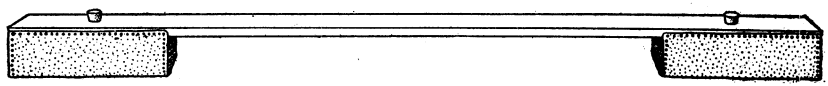

FIG. 7.—"Bag and pole" for use in distributing poison in bollworm control.

To get best results the dusting should be done when the plants are covered with dew. This necessitates making the application during the night or in the early morning hours. Windy periods should be avoided.

It should be remembered that all of these arsenicals are poisonous to man and animals although they are not dangerous if properly handled. Calcium arsenate is less injurious to man than Paris green. Men employed in distributing the poison should change their clothes and bathe immediately after ceasing work. No case of poisoning of animals used in drawing the machines has been observed, but if they are inclined to eat the cotton plants it is best to safeguard them by using muzzles.

The number of applications should depend largely on the abundance of eggs deposited during the few weeks following the first application. Some years the bollworms appear in great numbers at one time while in other seasons they are more or less distributed through the late summer. On the average it is believed that two applications of poison 7 to 10 days apart will give best results. If a heavy rain should follow within 24 hours after an application another treatment should be given. After the poison is well dried on with the dew it will withstand considerable rain.

[1] For discussion of dusting machinery for boll-weevil control see Farmers' Bulletin 1098.

In rather extensive experiments an average return of $5.21 per acre over the cost of poison and expense of application resulted. Some of the fields were treated once and others received two applications.

In sections where poisoning for the boll weevil[1] is practiced, ordinarily a high degree of control of the bollworm should result. In sections where the boll weevil and bollworm are both frequently bad an attempt should be made to follow the infestations in the fields closely enough to make applications of the poison at the proper time to check the ravages of both of these pests.

On account of the sporadic occurrence of bollworms in great numbers in most regions it is rather difficult to foresee just when serious injury is to occur, but it would no doubt be profitable to apply poison each year in the portions of Texas and Oklahoma where bollworm damage is general and more severe.

CORN AS A TRAP CROP TO PROTECT COTTON.

Since the bollworm prefers corn to cotton or most other plants for food it is possible to concentrate the larvæ on corn and keep them from becoming so numerous on cotton. To effect such a result it is important that corn be planted at such a time as to be in silk and tassel about the 1st of August. If it matures too early it will act only as a breeding place for bollworms, which will mature as the ears harden and a short time later transform to moths which in turn will deposit eggs over adjacent cotton fields. On the other hand, if the plants are in an attractive state, the moths, which fly quite freely, will assemble in the corn from considerable distances and deposit most of their eggs on the corn plants. These eggs will hatch and the young larvæ, being so numerous, will destroy one another to such an extent that usually not more than a few out of the many hatching on the silk of each ear will reach maturity.

One plan of planting the trap rows consists of leaving belts from 10 to 40 feet wide across the field at the time the cotton is planted and about June 1 planting this space with Mexican June corn in rows 5 or 6 feet apart. About 10 days later a row of cowpeas may be planted between the corn rows, thus leaving room for cultivation and at the same time furnishing attractive places for the bollworm moths, which will concentrate in the trap rows in great numbers. While any variety of corn may be used, the Mexican June corn is more desirable in the Southwest on account of its resistance to drought.

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[1] The poisoning of the boll weevil is discussed in Bulletin 875 and Department Circular 162 of the United States Department of Agriculture and in Farmers' Bulletin 1262.

Another system is to plant patches of June corn and cowpeas here and there over the plantation following such crops as oats, wheat, and potatoes. This provides a trap crop for the bollworm, results often in a good yield of corn, and in a crop of cowpeas, which is valuable as green manure or for food and forage.

CONTROL ON TOMATOES.

The worms usually begin attacking the tomato crop before the fruit is set and continue their work until frost. At first they feed on the tender leaves at the tips and burrow into the stems. Later they attack the buds and flowers, then the small fruits, and continue the damage even when the fruit is ripening.

The feeding habits of the larvæ early in the season render the use of arsenical poisons effective, and as the worms pass from one fruit to another poison will destroy many of them later, but it is not advisable to use poisons later than 10 days before harvesting begins. As the first clusters of tomatoes are of greatest value, especially in the trucking regions of the South, the early use of poisons where bollworms cause trouble undoubtedly would net good returns.

On tomato lead arsenate should be used rather than Paris green in order to prevent burning. This material may be applied in dust form or as a spray. For the spray about 2 pounds of the lead arsenate in the paste form or 1 pound of zinc arsenite dissolved in 50 gallons of water should be used per acre. The use of about 3 pounds per acre of calcium arsenate or powdered arsenate of lead applied as a dust is recommended. The first application should be made as soon as the moths are observed in the field or injury to the leaves and stalks is noticed, and succeeding treatments should follow at about weekly intervals. If fungicides (such as Bordeaux mixture) are used against diseases of the tomato, the arsenical may be added to these.

While some are averse to using poisons on crops of this kind, no injurious effects are likely to occur, especially if the applications are discontinued some time before picking begins. The early treatments are most effective, as at this time the worms are not feeding within the large tomatoes and are thus most easily reached.

CORN AS A TRAP CROP TO PROTECT TOMATOES.

The principle of trapping described for the protection of cotton can be utilized in controlling the bollworm on tomatoes. It is advisable, however, to modify it somewhat. As the moths deposit eggs on the plants during a considerable period, it is desirable to have corn in silk and tassel from the time the fruit begins to set on the tomatoes until harvesting is over. It is advisable to use small areas immediately adjacent to tomato patches and plant portions of these

at two-week intervals, thus bringing a succession of plants into silking during the fruiting period of the tomato. If a large acreage is in tomatoes, it is advisable to plant a few strips of corn through the field in addition to those on the margins. As the ears become sufficiently mature for roasting they should be gathered to prevent the escape of the worms. If these worms are allowed to leave the ears in the fields, they will produce moths which in turn may cause an infestation of the tomatoes. Either field corn or sweet corn may be used as a trap crop under these conditions.

CARE OF INFESTED FRUIT.

The poison treatment should be supplemented by picking and destroying all wormy tomatoes. These should not be left in the field, as the worms will emerge from them and return to the plants or produce moths which will multiply greatly the number of the worms later in the season.

CONTROL ON TOBACCO.

A number of authorities state that where the false budworm[1] is injurious to tobacco, notably in Georgia and Florida, damage can be prevented largely, though at a considerable expense, by sifting by hand into the bud a mixture of powdered arsenate of lead and corn meal. One pound of the poison is used to 75 pounds of corn meal[2] and applications to shade tobacco are made twice a week. No doubt corn can be utilized as a trap crop to some extent as recommended for the protection of tomatoes.

INEFFECTIVE METHODS OF CONTROL.

The burning of lights for the attraction of moths in fields is not uncommon in certain sections and the idea of trapping the moths by various devices is advocated often. Both of these methods have been tested thoroughly and found of little or no value. In the first place most of the moths caught are males, or females which have deposited their full quota of eggs, and in the second place a great many beneficial insects which prey upon the bollworm in different stages are destroyed. The placing of poisoned sweets in pans in the cotton field also has been found to be a useless practice.

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[1] A local name for the bollworm, *Chloridea obsoleta* Fab.

[2] Extensive experiments have been made with many carriers, but none of them have given satisfactory results except the corn meal.

PUBLICATIONS OF UNITED STATES DEPARTMENT OF AGRICULTURE RELATING TO INSECTS INJURIOUS TO COTTON OTHER THAN THE BOLL WEEVIL.

AVAILABLE FOR FREE DISTRIBUTION BY THE DEPARTMENT.

The Fall Army Worm, or "Grass Worm," and Its Control. (Farmers' Bulletin 752.)

The Red Spider on Cotton and How to Control It. (Farmers' Bulletin 831.)

Carbon Disulphid as an Insecticide. (Farmers' Bulletin 799.)

How Insects Affect the Cotton Plant and Means of Combating Them. (Farmers' Bulletin 890.)

FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS, GOVERNMENT PRINTING OFFICE, WASHINGTON, D. C.

The Argentine Ant: Distribution and Control in the United States. (Department Bulletin 377.) 1916. Price, 5 cents.

The Red Spider on Cotton. (Department Bulletin 416.) 1917. Price, 20 cents.

Two Destructive Texas Ants. (Entomology Circular 148.) 1912. Price, 5 cents.

Cotton Stainer. (Entomology Circular 149.) 1912. Price, 5 cents.

Cotton Worm or Cotton Caterpillar. (Entomology Circular 153. 1912. Price, 5 cents.

Report on Miscellaneous Cotton Insects in Texas. (Entomology Bulletin 57.) 1906. Price, 5 cents.

Cotton Stalk-borer. Entomology Bulletin 63, pt. VII.) 1907. Price, 5 cents.

Mexican Conchuela in Western Texas in 1905. (Entomology Bulletin 64, pt. I.) 1907. Price, 5 cents.

Notes on Economic Importance of Sowbugs. (Entomology Bulletin 64, pt. II.) 1907. Price, 5 cents.

Plant-bugs Injurious to Cotton Bolls. (Entomology Bulletin 86.) 1910. Price, 20 cents.

Argentine Ant. (Entomology Bulletin 122.) 1913. Price, 25 cents.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1922